

REMARKS

Claims 16, 17 and 19-41 are currently pending in the application. By the present amendment, claims 16, 22 and 36 have been amended for the Examiner's consideration. Claim 16 is amended to correct a grammatical error, and claim 36 is amended to address an antecedent issue. Claims 39-41 have been added for consideration by the Examiner. Applicants submit that no new matter is added by the above amendment. Support for the newly added claims, for example, is provided at paragraphs 0009, 0010 and 0021 of the present specification. Reconsideration of the rejected claims in view of the above amendments and below remarks is respectfully requested.

35 U.S.C. §112, 2nd Paragraph Rejection

Claim 36 was rejected under 35 U.S.C. §112, 2nd paragraph for lacking antecedent basis. Claim 36 has been amended to address this issue. Accordingly, Applicants respectfully request the rejection of claim 36 be withdrawn.

35 U.S.C. §103 Rejection

Claims 16, 17, 19, 22-24, 28-35, 37 and 38 were rejected under 35 U.S.C. §103(a) for being obvious over U.S. Patent No. 7,077,207 to Stark¹. Claims 20, 25, 26 and 36 were rejected under 35 U.S.C. §103(a) for being obvious over Stark, Rohlfing and U.S. Patent No. 5,302,294 to Schubert. Claims 21 and 27 were rejected under 35 U.S.C. §103(a) for being obvious over Stark, Rohlfing and U.S. Patent No. 6,260,627 to Rivas. These rejections are respectfully traversed.

The examiner bears the initial burden of factually supporting any *prima facie* conclusion of obviousness. If the examiner does not produce a *prima facie* case, the applicant is under no obligation to submit evidence of nonobviousness. See MPEP §2142. To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of

¹ Applicants note that in the body of the rejection, the Examiner asserts that Rohlfing discloses certain features. For this reason, Applicants will address this rejection as Stark in view of Rohlfing.

ordinary skill in the art, to modify the reference or to combine reference teachings.² Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

By way of background, the principle of Rohlring is that multi-phase mixtures are separated inside a positive displacement pump and a part of the separated fluid of the pumped fluid is recirculated inside the displacement pump. By the recirculation, the thermal stability is improved as well as the lubrication of the spindles and the sealing of the gaps between the spindles. Only the absolute necessary amount of liquid phase is recirculated to avoid an unnecessary reduction of the efficiency. To maximize the efficiency of the pump, especially in multi-phase applications, is very important and of high interest for a user of the multi-phase pumps.

Rohlring is restricted to displacement pumps. A special feature of a displacement pump is that the delivery is based on volumetric displacement which means that inside the compartments created by the spindles no compression takes place. This means, for multi-phase mixtures that for a high volumetric amount of a gas phase, a relative big pump has to be used. The bigger the pump the bigger the pump installation and the bigger the investments and running costs for delivery of multi-phase mixtures.

Coming from Rohlring, the presently claimed invention provides a method and an installation that is very efficient, reliable and cheap. The present invention splits off a part of the already pumped liquid to use it for pre-compression of the gas phase. For a person of skill in the art, it would not have been obvious to split off a partial liquid flow from the main delivery flow, which means from that medium that is pumped from the hydrocarbon bore hole and to feed it to a jet pump. This is because a jet pump has an extraordinary low efficiency of 25% to 30%. Because of the low efficiency, a jet pump is not very interesting for a skilled artisan for the

² While the *KSR* court rejected a rigid application of the teaching, suggestion, or motivation (“TSM”) test in an obviousness inquiry, the [Supreme] Court acknowledged the importance of identifying “a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does” in an obviousness determination. *Takeda Chemical Industries, Ltd. v. Alphapharm Pty., Ltd.*, 492 F.3d 1350, 1356-1357 (Fed. Cir. 2007) (quoting *KSR International Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 1731 (2007)).

pumping or delivery of multi-phase mixtures. Simply, it is not possible to create high hydraulic power with a jet pump.

Contrary to that opinion, the present invention uses a jet pump especially for volumetric big amounts of multi-phase mixtures and uses a high energetic liquid flow as a carrier flow. Instead of a high hydraulic power the carrier flow of the separated main delivery flow is used to pre-compress the high volumes of gas phase to provide the multiphase displacement pump with as little volumes as possible at little input pressures. With a relative low input of carrier fluid energy it is possible to provide limited partial pressures which leads to relative small pressures on the input side of the displacement pump and a considerable compression of the gas phase. By this, a volumetric reduction of the gas phase can be provided, so that the overall efficiency is increased.

By the combination of divergent parameters (intended maximum efficiency, split off of already pumped liquid, using of jet pump with low efficiency) it is possible to reduce the size of the pump. When splitting of a partial liquid flow to use it as a carrier fluid for a jet pump it is normally expected that the size of the pump has to be increased to compensate for the low efficiency of the jet pump. Because of the pre-compression of the gas phase it came to the surprising effect that the overall efficiency is increased and the size of the pump installation can be reduced.

Stark, on the other hand, is related to the problem of pumping material from the bottom of wells whose depth below the surface is 10 or more meters. In Stark, the pump is a circular pump. The carrier fluid is separated from the hydrocarbons in a separator in a flow direction before reaching the circular pump; whereas, a special carrier fluid is used to drive the jet pump of the present invention. As can be taken from column 3, lines 47 to 50 of Stark, an advantage that the transported material (risk material) does not have to be routed through the circulating pump as it may be stripped out in the separator unit so that only the carrier liquid is returned to the pump. More specifically, Stark discloses:

The risk material does not need to be routed through the circulating pump 3, as it may be stripped out in a separator unit 9 and only the carrier liquid returned to the pump 7.

According to Stark the main delivery flow is the flow of the carrier stream because that is the flow leaving the pump on its high-pressure side.

Also, a circulating pump is not a displacement pump, it is a rotational pump. Low multi-phase mixture is pumped through the circulating pump but only the liquid phase of the carrier fluid. There is no splitting off of a partial liquid from the main delivery flow on the pressure side of the circulating pump. If the stripped high draw caverns are regarded as the main delivery flow, because only that is delivered to the facilities, and moreover nothing is recirculated to the jet pump.

Moreover, according to Stark, separation of a gas phase and a liquid phase does not take place in the pump, especially not in a displacement pump. This is because the circulating pump is not a displacement pump. Stark discloses a separation in a separate separator in front of the circulating pump. According to Stark, the hydrocarbons are “guests” in the carrier stream, the carrier stream is circulated by the circulating pump and the hydrocarbons will never reach the circulating pump.

Stark also discloses a compression of the gas phase but the compression is not used as a pre-compression to reduce the volumetric amount pumped by a displacement pump because in Stark it is mentioned that the hydraulic pressure decreases and the lifting effect of the liquid phase becomes effective so that the compression effect does not take place anymore. The compression of the gas phase is not that relevant in Stark because the gas phase will not reach the circulating pump.

A combination of Stark and Rohlfing would lead to the replacement of the circulating pump of Stark by the displacement pump of Rohlfing, what would increase the size of the displacement pump because of the low efficiency of the jet pump. The pump according to Rohlfing would not be necessary because no recirculation is necessary since the pump (according to Stark) will pump liquid fluid only because of the pre-arranged separator. A combination of Stark and Rohlfing would not have led to a reduction of the size and an increase of efficiency but to the contrary to an increase of size of the pumping and a decrease of efficiency.

Independent Claim 16

The present invention relates to a method for delivering a multi-phase mixture. Claim 16 recites, in pertinent part:

. . . using a displacement pump through which the multi-phase mixture is pumped, comprising, on a pressure side, splitting off a partial liquid flow from a main delivery flow and guiding the split partial liquid flow to a high-pressure side of at least one ejector pump arranged on a suction side of the displacement pump as an auxiliary delivery device,

further comprising carrying out a separation of a gas phase and a liquid phase in the displacement pump, wherein the partial liquid flow to the ejector pump is split off from the separated liquid phase.

Applicants submit that a combination of Stark and Rohlfing do not show the features of the claimed invention.

The Examiner is of the opinion, though, that

Stark discloses a method for delivering a multi-phase mixture from a well using a displacement pump (3), comprising splitting off a partial liquid flow from a main delivery flow (within separator 9) and guiding the split partial liquid flow (via outer tubing 21) to a high-pressure side of at least one ejector pump (7) arranged on a suction side of the displacement pump as an auxiliary delivery device. Stark's separator is distinct from the displacement pump, therefore the partial liquid flow is split off before the flow reaches the displacement pump (i.e. on the suction side of the displacement pump, rather than the pressure side). Stark also does not disclose pumping the multi-phase mixture through the displacement pump, since the gas is removed by the separator before it reaches the pump.

Rohlfing discloses a screw-type pump which is a combined displacement pump and separator.

Applicants submit that Stark is directed to a double cone device and pump. More specifically, as shown in FIG. 1, for example, a DCT well-pump installation 1 comprises a circulating pump 3, a system of double-walled tubing 4, an open double-cone (ODC) unit 7 and an optional separator unit 9. The circulating pump 3 is placed at the surface 11, and supplies either the inner 13 or outer 15 section of the double-walled tubing 4, which links the pump 3 to the ODC unit 7. The ODC unit 7, which is placed at the bottom 17 of the well 19, draws the liquids 20 and/or gases to be pumped through the inlet 22 into the circulating stream 21. The resulting mixture passes directly into the exhaust section 23 of the double-walled tubing and rises to the surface 11 as indicated by upwardly directed arrows 25. This mixture enters the separator 9 at the surface where the carrier liquid is stripped out and returned to the circulating pump 9 (arrow 27). Then, only the liquid is brought back to the ODC unit 7. This is not a partial liquid flow.

Applicants also note that the circulating pump 3 is not a displacement pump. A circulator pump is a specific type of pump used to circulate gases, liquids, or slurries in a closed circuit. Because they only circulate liquid within a closed circuit, they only need to overcome the friction of a piping system (as opposed to lifting a fluid from a point of lower potential energy to a point of higher potential energy). Circulator pumps as used in hydronic systems are usually electrically powered centrifugal pumps. On the other hand, a displacement pump is a pump that develops its action through the alternate filling and emptying of an enclosed volume. There are five basic types: reciprocating, direct-acting steam, rotary, vacuum, and air-lift. (<http://www.answers.com/topic/displacement-pump>).

Additionally, the separator 9 of Stark is not splitting off a partial liquid flow from a main delivery flow on a pressure side of the circulator pump. Instead, the splitting off a partial liquid flow is provided in the separator 9, prior to being put into the circulator pump 3. Also, according to Stark, separation of a gas phase and a liquid phase does not take place in the pump, especially not in a displacement pump. This is because the circulating pump is not a displacement pump. Stark discloses a separation in a separate separator in front of the circulating pump. According to Stark, the hydrocarbons are “guests” in the carrier stream, the carrier stream is circulated by the circulating pump and the hydrocarbons will never reach the circulating pump. For this reason, Stark also does not contemplate guiding the split partial liquid flow to a high-pressure side of at least one ejector pump. In Stark, only liquid is being provided back to the ODC unit 7.

Rohlfing is directed to a multi-phase pumping process and pump, wherein the multi-phase stream is separated into a liquid portion and a gas portion. A partial liquid volume flow (around 3 percent) is recirculated through the pump to “wet the shaft seals permanently and sufficiently.” The remainder of the liquid volume flow (i.e., the surplus liquid volume flow (see claim 1)) and the gas portion are then recombined at the outlet and output by the pump. However, it is noted that the liquid is required within the pump in order to maintain a lubrication, the liquid is recirculated by using line 14 to stub 5, and that the outlet includes a high concentration of gas, as it appears that all of the gas is being output from the pump. For this reason, Rohlfing does not show all of the features of the claimed invention.

Also, Applicants respectfully submit that the Examiner-proposed modification of Stark (i.e., the substitution of the pump of Rohlfing for the pump and separator of Stark) would render Stark unsatisfactory for its intended purpose. Applicants note that if a proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. MPEP 2143.01. *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984). Additionally, Applicants note that if the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. *In re Ratti*, 270 F.2d 810, 123 USPQ 349 (CCPA 1959).

In the present case, Stark specifically discloses:

17. The risk material does not need to be routed through the circulating pump 3, as it may be stripped out in a separator unit 9 and only the carrier liquid returned to the pump 7.

18. The carrier liquid may be chosen so as to "neutralise", or preferentially transport selected fractions.

However, were Stark to be modified as the Examiner asserts, the proposed combination would result in an apparatus in which the pump of Rohlfing is substituted for the pump and separator of Stark. However, there is no teaching or suggestion in Stark or Rohlfing that such a substitution of pumps would be successful. That is, there is no teaching or suggestion that the

pump of Rohlfing, which operates in a different manner than the pump and separator of Stark, would be able to maintain a flow rate or allow separation of fluids. For example, using the pump of Rohlfing would run the risk that material would be routed through the pump, and that gas would be carried through the lines and into the ODC unit 7; whereas, Stark is very clear that only liquid is to be run through the ODC unit 7.

In fact, Applicants submit that by using the pump of Rohlfing, both liquid and gas will exit the output. Thus, by using the pump design of Rohlfing, gas would also be brought to the ODC unit 7 of Stark, which is contrary to its teaching. Also, by having gas fed to the ODC unit 7, the flow rate, pressure and other variables would be affected, possibly destroying the pumping ability of Stark. For example, by changing the Stark pump for Rohlfing, it may not be possible to provide all of the following features, which would be contrary to Stark:

1. Will pump gases, liquids and suspensions either individually or as a mixture.
2. Uses a carrier liquid.
3. The carrier liquid may be optimised for any given application.
4. The carrier liquid is driven by a circulating pump whose delivery pressure can be much less than that represented by the depth of the well in terms of static pressure.
5. The pump is not damaged if any of the following situations occurs: The outlet is closed. The inlet is closed. Both outlet and inlet are closed.
6. The down-the-well ODC can function with either a negative or positive gauge pressure applied at its inlet 22.
7. The pump is pulse free.
8. The pump can work against high pressures.
9. The pump may be used for both continuous and batch-wise production.
10. The ODC unit 7 can be placed at a great distance from the circulating pump 3.
11. The circulating pump 3 can be placed in a safe location near a power supply, whilst the ODC unit 7 is located at the desired suction point.
12. The overall pump efficiency is an increasing function of the environmental and system pressure in the vicinity of the ODC unit 7.
13. On plunging the ODC unit to a depth well below the surface, FIG. 1, the DCT pump displays a much higher hydraulic efficiency than that obtained with the ODC unit at the surface.

14. A wide range of multi-phase mixtures may be handled, including any mix of the following components: Small solid particles; Low viscosity sludges; Liquids; Gases.
15. The entire pump may be set up so that it can be sterilised.
16. Dangerous mixtures may be pumped.
17. The risk material does not need to be routed through the circulating pump 3, as it may be stripped out in a separator unit 9 and only the carrier liquid returned to the pump 7.
18. The carrier liquid may be chosen so as to "neutralise", or preferentially transport selected fractions.

Accordingly, Applicants respectfully submit that there is no suggestion or motivation to make the proposed modification. Additionally, Applicants submit that the Examiner-proposed modification of Stark would change the principle of operation of Stark. That is, as explained above, Stark discloses such an arrangement of the pump and separator in order to eliminate the risk that unwanted material is routed through the pump. However, Applicants submit that replacing the separator and pump of Stark with the pump of Rohlfing would change the principle of operation of Stark.

Thus, for at least these reasons, Applicants respectfully submit that Stark in view of Rohlfing does not render claim 22 unpatentable.

Independent claim 22

Independent claim 22 recites, in pertinent part:

...
 at least one separation device is provided within the displacement pump housing to divide a gas phase from a liquid phase in the pressure chamber,
 a suction line configured to open out into a well, and
 a feed line connecting the pressure chamber of the displacement pump with a high-pressure side of at least one jet ejector pump arranged on a suction side in a delivery direction of the displacement pump and which guides the separated liquid phase to the ejector pump.

In addressing claim 22, the Examiner asserts that Stark teaches or suggests all of the features of the present invention, except for "the separator being located within the displacement

pump.” Additionally, the Examiner asserts that Rohlfing teaches a screw-type pump that is a combined displacement pump and separator. Moreover, the Examiner asserts:

It would have been considered obvious to one of ordinary skill in the art, at the time the invention was made, to have combined the displacement pump and separator of Stark into a single housing, as shown by Rohlfing, in order to have reduced the space on the well site occupied by the pump and separator, and because it has been held that forming in one piece an article which has formerly been formed in two pieces and put together involves only routine skill in the art. *Howard v. Detroit Stove Works*, 150 U.S.164 (1993).”

For the reasons set forth above with regard to claim 16, Applicants respectfully disagree with the Examiner’s assertion that it would have been obvious to combine Stark and Rohlfing in the manner asserted. That is, Applicants submit that the Examiner-proposed modification of Stark, would render Stark unsuitable for its intended purpose and would change the principle of operation of Stark. Accordingly, Applicants respectfully submit that the teachings of the references are not sufficient to render the claims *prima facie* obvious.

Also, Applicants submit that no reference, alone or in any combination, teach the use of a jet ejector pump. And, for a person of skill in the art, it would not have been obvious to split off a partial liquid flow from the main delivery flow, which means from that medium that is pumped from the hydrocarbon bore hole and to feed it to a jet pump. This is because a jet pump has an extraordinary low efficiency of 25 to 30%. Because of the low efficiency, a jet pump is not very interesting for a skilled artisan for the pumping or delivery of multi-phase mixtures. Simply, it is not possible to create high hydraulic power with a jet pump. However, contrary to that opinion, the present invention uses a jet pump especially for volumetric big amounts of multi-phase mixtures and uses a high energetic liquid flow as a carrier flow. Instead of a high hydraulic power the carrier flow of the separated main delivery flow is used to pre-compress the high volumes of gas phase to provide the multiphase displacement pump with as little volumes as possible at little input pressures. With a relative low input of carrier fluid energy it is possible to provide limited partial pressures which leads to relative small pressures on the input side of the displacement pump and a considerable compression of the gas phase. By this, a volumetric reduction of the gas phase can be provided, so that the overall efficiency is increased.

Thus, for at least these reasons, Applicants respectfully submit that Stark in view of Rohlfing does not render claim 22 unpatentable.

Dependent Claims

Claims 17-21 and 23-38 are dependent claims, depending from a respective distinguishable independent claim. By virtue of these dependencies, claims 17-21 and 23-38 are also in condition for allowance.

Applicants also submit that many of the features in these claims are distinguishable on their own merits. For example, Applicants submit that Stark and Rohlfing do not show short-circuited line leading from a pressure-chamber side to the suction side of the displacement pump for portioned feeding of the separated liquid phase, as recited in claim 24. Stark does not show a short circuited line, nor does Rohlfing. In Rohlfing, the line 14 is provided from a pressure chamber 11 to the suction side 10 of the pump itself.

As to claim 33, as discussed above, Stark does not show using a partial liquid flow. In stark, it would appear that only liquid is brought to the ODC 7. Also, there is no disclosure in Rohlfing that the partial liquid flow can be used to drive an ejector pump without any contamination.

New Claims

Claims 39-41 are newly added claims. Applicants submit that these claims are dependent claims, and by virtue of these dependencies, are also in condition for allowance. Additionally, Applicants submit that these claims are distinguishable on their own merits. For example, none of the applied art teaches or suggests, in any combination, that the partial liquid flow has a gas proportion and a liquid phase, where the liquid phase corresponds to a delivered product and the partial liquid flow is substantially free of a gas phase. In fact, Applicants submit that Rohlfing would teach away from these features. The references also do not teach guiding a partial fluid through a jet pump, as discussed above. This would not have been contemplated by an ordinarily skilled person in the art due to known inefficiencies in jet pumps.

CONCLUSION

In view of the foregoing amendments and remarks, Applicants submit that all of the claims are patentably distinct from the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue. The Examiner is invited to contact the undersigned at the telephone number listed below, if needed. Applicants hereby make a written conditional petition for extension of time, if required. Please charge any deficiencies in fees and credit any overpayment of fees to Attorney's Deposit Account No. 50-2478.

Respectfully submitted,
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